PATENT CLAIMS

1. System for compensating distortions induced by polarisation modulation dispersion (PMD) in optical transmission systems and in transmission fibres in particular, comprising
   - a means for measuring PMD-induced distortions,
   - an emulator unit for adjustable PMD levels, and
   - a controller which the output signal of said measuring means is applied to and which serves to control said emulator unit,

   characterised in that said controller controls said PMD emulator unit in such that continuous compensation of the PMD-induced signal distortion will be performed.

2. System according to Claim 1,
   characterised in that said PMD emulator unit includes a variable PMD delay unit which consists of two PMD-involving elements with a polarisation regulator disposed therebetween.

3. System according to Claim 2,
   characterised in that said PMD-involving elements are dispersive elements.

4. System according to Claim 3,
   characterised in that said PMD-involving elements of said variable PMD delay element are polarisation-maintaining fibres.

5. System according to Claim 2,
   characterised in that said polarisation regulator of said variable PMD delay element comprises a $\lambda/2$ wave plate or a Faraday rotator.

6. System according to Claim 2,
   characterised in that said polarisation regulator is implemented by a rotatable connection of the coupling site of the two PMD-involving elements.

7. System for compensating distortions induced by polarisation modulation dispersion (PMD) in optical transmission systems and in transmission fibres in particular, comprising
   - a means for measuring PMD-induced distortions,
   - an emulator unit for adjustable PMD levels, and
   - a controller which the output signal of said measuring means is applied to and which serves to control said emulator unit,

   characterised in that said emulator unit comprises at least one basic emulator unit consisting of two DGD (differential group delay elements) elements having each a defined invariable time lag for the incoming signal, which elements are connected to each other via a connecting element producing the effect of a transformation element, with all the three elements having a defined angle of the birefringence axes such that the birefringence axes of said connecting element will be distinguished in terms of their angular position from the birefringence axes of said two DGD elements, and

   that at least one regulator element is provided for each basic emulation unit, which acts upon one of said elements of this basic emulator unit in such a way that the DGD level of the system can be completely adjusted by a slight variation of the time lag of the influenced element.

8. System according to Claim 7,

   characterised in that said elements are PM fibres, and

   that said regulator element exerts a mechanical effect upon at least one of said DGD elements for varying the time lag and hence polarisation.

9. System according to Claim 8,

   characterised in that said regulator element or elements, respectively, which produce a mechanical action, are fibre squeezers or stretchers with electrically controllable elements such as piezo elements creating a mechanical action upon the PM fibre.

10. System according to Claim 9,
characterised in that at least one of said regulator elements comprises a ring onto which said PM fibre is wound without being twisted, for distributing the mechanical action over the longest fibre length possible.

11. System according to Claim 4 or 10,
characterised in that at least one pressurising element creates a pressure on a plurality of fibre segments of said wound fibre at least at one site.

12. System according to Claim 11,
characterised in that said pressurising element is an elongating element such as a piezo element that acts upon at least one circle segment bearing against said ring, and
that counter-segments are provided for at least one part of said circle elements, which bear against said fibre segments and create pressure on said fibre.

13. System according to Claim 1 or 7,
characterised in that said elements are birefringent crystals having a birefringence adapted to be electronically influenced.

14. System according to Claim 1,
characterised in that the time lag of said two DGD elements of each basic emulator unit is equal to and distinctly greater than that of the associated connecting element.

15. System according to Claim 7,
characterised in that the angle of the birefringence axis of said first DGD element is selected to be 0° and that of the second DGD element to be 90° and that of said connecting element to be 45°, or to be 0°, 45°, 0°, or 90°, 45°, 0°.

16. System according to Claim 7,
characterised in that a further element is series-connected to said two DGD elements and said connecting element for setting an optional input PSP.

17. System according to Claim 16,
characterised in that said series-connected element comprises a further birefringent element such as a PM fibre, and
that the angle of said birefringence axes of said series-connected element and of said first DGD element are different from each other.

18. System according to Claim 17,
characterised in that said angular difference amounts to 45°.

19. System according to Claim 16,
characterised in that said series-connected element comprises a further birefringent element such as a PM fibre, and
that a regulator element produces an effect on said first DGD element for varying the time lag and hence the polarisation.

20. System according to Claim 19,
characterised in that said series-connected element and/or said connecting element consists of two PM fibres or two birefringent crystals having each a different angular position of the birefringence axes.

21. System according to Claim 19,
characterised in that said regulator element acts upon one of said two fibres or on one of said crystals.

22. System according to Claim 7,
characterised in that at least two systems for setting a variable DGD are connected in tandem, whereof at least one comprises a basic emulator unit, if necessary with a PSP setting element.

23. System according to Claim 22,
characterised in that the individual systems for higher-order PMD compensation consist of basic emulator units with DGD elements having different individual time lags.

24. System for compensating distortions induced by polarisation modulation dispersion (PMD) in optical transmission systems and in transmission fibres in particular, comprising
- a means for measuring PMD-induced distortions,
- an emulator unit for adjustable PMD levels, and
- a controller which the output signal of said measuring means is applied to and which serves to control said emulator unit,

characterised in that said measuring means detects the polarisation of all spectral fractions contained in the signal output from said emulator unit, for detecting the PMD.

25. System according to Claim 24,
characterised in that said measuring means comprises a polarizer and an opto-electrical converter such as a photo receiver that is disposed to join said polarizer, and
that a polarisation matching unit is provided that matches the output polarisation of said emulator unit to that of said polarizer.

26. System according to Claim 24,
characterised in that said measuring means comprises a polarisation beam splitter, with opto-electrical converters such as photo receivers being provided on the output terminals of said splitter and issuing signals for generating an ACTUAL signal for said controller, which are subjected to quotient formation.

27. System according to Claim 26,
characterised in that for detection of the polarisation a polarimeter array known per se is provided.

28. System according to Claim 24,
characterised in that said polarisation matching unit comprises two birefringent elements having birefringence axes forming an angle different from 0°, preferably 45°, and
that at least one regulator element is provided for setting the output polarisation, which acts upon at least one of said birefringent elements.

29. System according to Claim 28,
characterised in that said birefringent elements are birefringent crystals or PM fibres.

30. System according to Claim 1, 7 or 18,
characterised in that a polarisation matching unit is disposed directly upstream of said polarisation measuring unit or directly downstream of said emulator.

31. System according to Claim 1, 7 or 18,
characterised in that a polarisation matching unit is integrated as additional element into said emulator.

32. System according to Claim 25,
characterised in that said polarisation matching unit is a series-connected upstream or downstream DGD element having an angle of 45°, with a regulator element acting upon this series-connected element and upon the DGD connected upstream or downstream thereof.

33. System according to Claim 1 or 31,
characterised in that said PMD emulator unit is a variable infinite polarisation regulator having sufficient degrees of freedom, which projects said two PSP of the fibre to be compensated onto the PSP of said variable PMD delay element, without thoroughly controlling a local minimum of the overall PMD.

34. System according to Claim 33,
characterised in that said variable polarisation regulator comprises an array of four λ/4 wave plates disposed in tandem.

35. System for compensating distortions induced by polarisation modulation dispersion (PMD) in optical transmission systems and in transmission fibres in particular, comprising
- a means for measuring PMD-induced distortions,
- an emulator unit for adjustable PMD levels, and
- a controller which the output signal of said measuring means is applied to and which serves to control said emulator unit,

or according to Claim 1, 7 or 18,
characterised in that said controller comprises several control loops in which it modulates regulator elements of said emulator unit with different frequencies, that said controller derives from the output signal of said measuring means information about the amount and the phase position of the signal output from said emulator unit, and uses this information to perform a high-speed and direct control function.

36. System according to Claim 35,
characterised in that the bandwidth or limit frequency of said opto-electrical converter is matched with the modulation frequency, and
that said controller sets the individual control loops in such a way that the polarisation will be constant for all spectral fractions contained in the signal.

37. System according to Claim 36,
characterised in that said controller uses a minimum photo current of said opto-electrical converter or converters as a control criterion for setting a constant polarisation for all spectral fractions contained in the signal.

38. System according to Claim 36,
characterised in that said controller evaluates the output signal from said opto-electrical converter or converters selectively in terms of frequency and phase.

39. System according to Claim 38,
characterised in that said controller comprises analog automatic-control circuits for said regulator elements to which said frequency-selective and phase-selective signals are applied.

40. System according to Claim 35,
characterised in that said controller also controls the regulator elements of said polarisation matching unit.

41. System according to Claim 40,
characterised in that said controller controls the regulator elements of said polarisation matching unit with the same control algorithm as that used in said emulator unit.

42. System according to Claim 35,
characterised in that said controller comprises at least one CPU or at least one DSP circuit for performing various functions such as for frequency-selective and phase-selective evaluation or for controlling the operational sequence within the system.

43. System according to Claim 35,
characterised in that said controller performs essential parts of said control algorithm by using analog circuits.

44. System according to Claim 1,
characterised in that said controller comprises filters for generating a control signal, which filter out high-frequency spectral fractions of the data signal so

that the filtered signal reflects the degree of distortion of said detected data signal.

45. System according to Claim 44,
characterised in that said controller comprises two different filters with respectively series-connected detectors on the output side, which generate two analog signals on the basis of said data signal, whose ratio reflects the degree of distortion of said data signal independently of the signal power.

46. System according to Claim 45,
characterised in that said controller minimises the PMD-induced signal distortion by readjustment, in alternation, at the polarisation-influencing elements of said variable polarisation regulator and said variable PMD delay element.